Global Land Surface Monitoring with Low Resolution Satellite Imagery

Christine A. Hlavka Jennifer L. Dungan, Gerry P. Livingston*

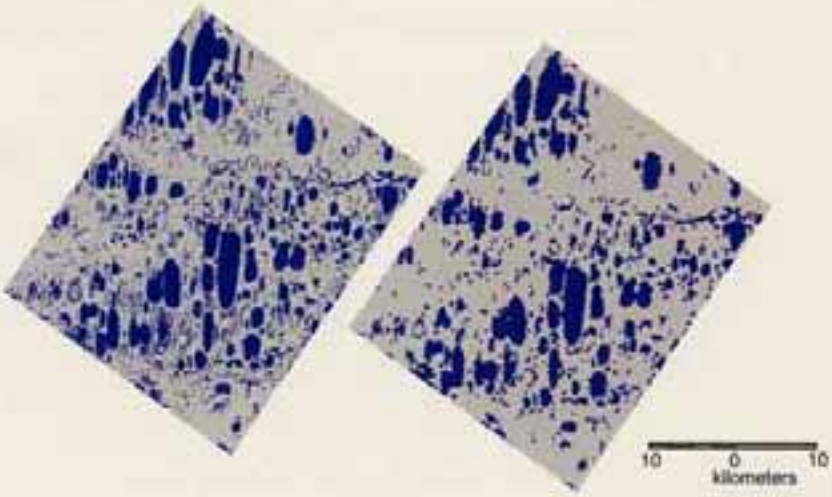
NASA Ames Research Center, Earth Science Division,
Ecosystem Science and Technology Branch

The land surface of the earth is being monitored to study natural processes and human activities that affect the global climate. One example of these processes is the widespread burning of forests and grasslands around the world that causes increases in greenhouse gases, especially carbon dioxide. A second example is the natural production of methane, another greenhouse gas, by wet tundra in far northern regions. The quantification of greenhouse gases depends on accurate estimates of the extent of critical land cover types such as ponds in Arctic tundra and burn scars throughout forested and grassland zones. To address the requirement for accurate areal estimates, regional to global maps are beginning to be made with low resolution satellite imagery. Low resolution imagery has large picture elements (pixels) that are about one kilometer on a side (from NOAA's AVHRR imagery) or 250 meters on a side (from NASA's soon-to-be launched MODIS instrument). These maps miss the smallest ponds or scars, since they are much smaller than a pixel, and overshoot the size of ponds or scars that are slightly larger than half a pixel. These are called "pixelation" effects. To accurately estimate areal extent with low resolution satellite imagery, we are developing a new procedure for estimating areal extent. It is based on modeling true extent of highly fragmented land cover types, such as open water in tundra, as a function of fragment size, and simulating pixelation effects.

* School of Natural Resources, University of Vermont

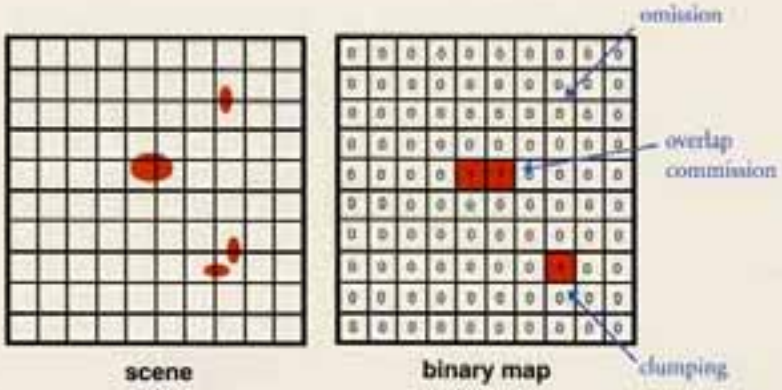
Surface Waters in Arctic Tundra

Surface waters near Point Barrow, Alaska mapped using an ERS-1 C-band Synthetic Aperture Radar (SAR) image (12.5 m resolution, left) and resampled to 250 m resolution (right).



Effects of Low Spatial Resolution

Scene with overlay showing grid defined by image pixelation (left). Binary map with pixelation effects (right).



Model and Extrapolation Concept

Actual total area of fragments is modeled as the area under a curve (red and purple). The observed area blue and purple) is affected by omission of small fragments (red), overlap commission (blue), and clumping (not shown).